CiteSpace——一种科学知识图谱工具

许煜远

主要内容

- 文献调研中存在的问题
- CiteSpace的解决方法
- 桥梁健康监测的科学知识图谱
- 总结

Part1：
文献调研中存在的问题

文献调研方法的改进

直接检索：直接检索高引用文献

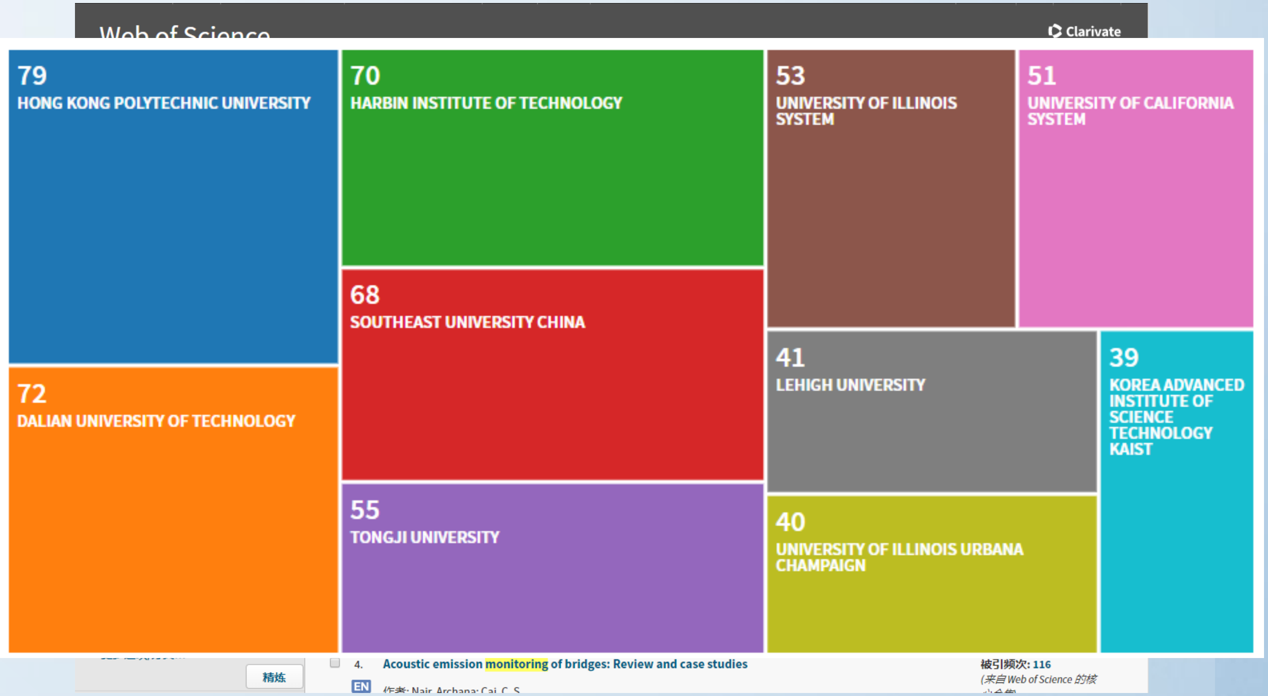
- 引用量并不能完全体现出文献的价值
- 无法判断文献之间的相互关系

绘制表格：利用excel等绘制表格

- 适合于对机构和国家的评价
- 无法找出关键的文献和彼此的关系

绘制图谱：对文献结果进行可视化

- 三大问题



4. Acoustic emission monitoring of bridges: Review and case studies

被引频次: 116

(来自 Web of Science 的核

图谱绘制中的难题

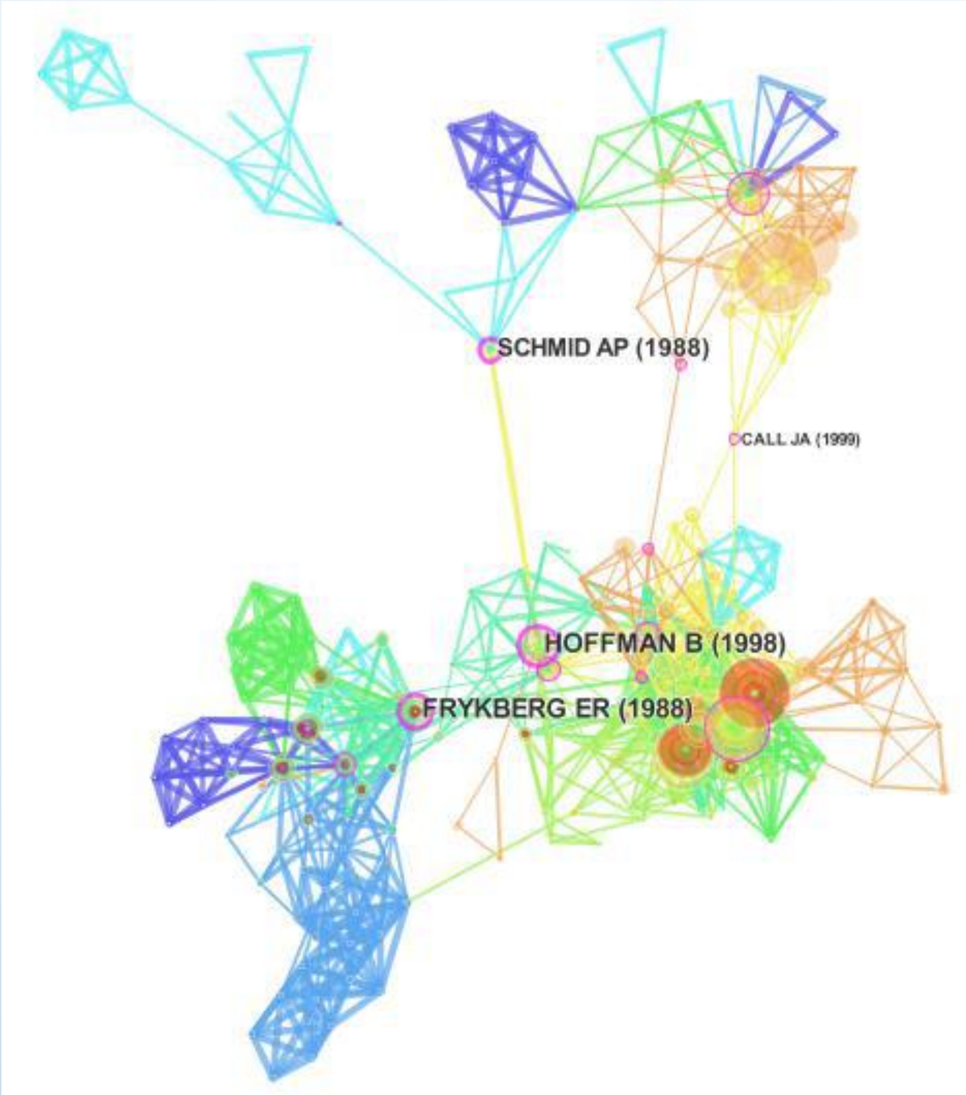
Q1:如何展现出学科发展的动态轨迹

Q2.如何让复杂的图谱简单明了

Q3.如何找出关键的文献：中心点、爆发点、枢纽点

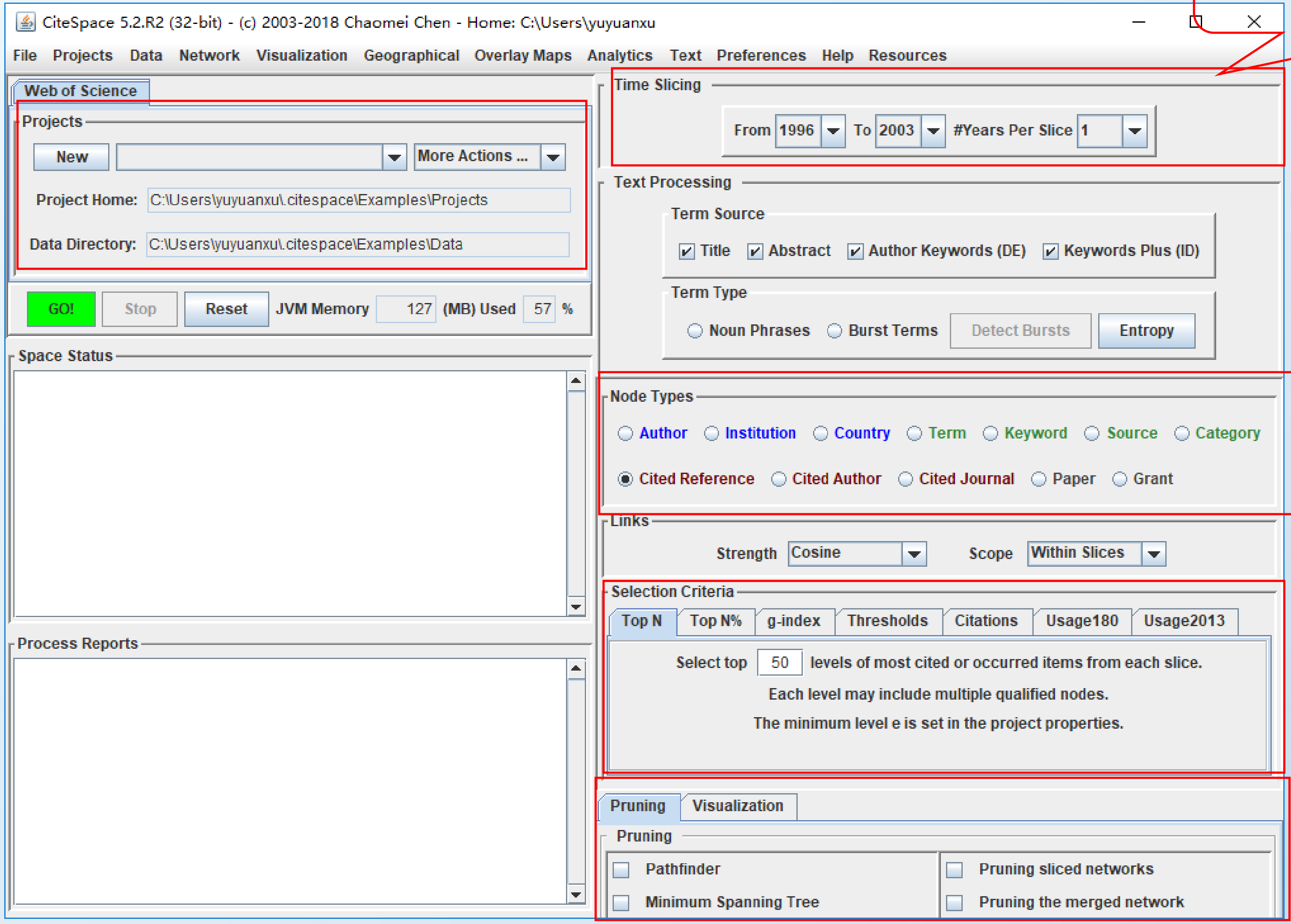
Part2：
CiteSpace的解决方法

CiteSpace简介



- CiteSpace是由德雷塞尔大学陈朝美（Chaomei Chen）2004年研发的一款着眼于分析科学分析中蕴含的潜在知识，是在科学计量学、数据可视化背景下逐渐发展起来的一款引文可视化分析软件。由于是通过可视化的手段来呈现科学知识的结构、规律和分布情况，因此也将通过此类方法分析得到的可视化图形称为“科学知识图谱”。
- 组成：Java运行环境、Jar程序
- 对电脑配置要求较高，建议使用台式机
- 学习资料：陈超美教授和李杰教授的博客、CiteSpace中文版指南、微信公众号“科学知识前沿图谱”、有关文献

从CiteSpace界面说起



CiteSpace 5.2.R2 (32-bit) - (c) 2003-2018 Chaomei Chen - Home: C:\Users\yuyuanxu

Projects

Project Home: C:\Users\yuyuanxu\.citespace\Examples\Projects

Data Directory: C:\Users\yuyuanxu\.citespace\Examples\Data

JVM Memory 127 (MB) Used 57 %

Time Slicing

From 1996 To 2003 #Years Per Slice 1

Text Processing

Term Source

☑ Title ☑ Abstract ☑ Author Keywords (DE) ☑ Keywords Plus (ID)

Term Type

○ Noun Phrases ○ Burst Terms

Node Types

○ Author ○ Institution ○ Country ○ Term ○ Keyword ○ Source ○ Category

● Cited Reference ○ Cited Author ○ Cited Journal ○ Paper ○ Grant

Links

Strength Cosine Scope Within Slices

Selection Criteria

Select top 50 levels of most cited or occurred items from each slice.

Each level may include multiple qualified nodes.

The minimum level e is set in the project properties.

Pruning

☐ Pathfinder ☐ Pruning sliced networks

☐ Minimum Spanning Tree ☐ Pruning the merged network

项目及数据位置

时间切片（抓拍频率）

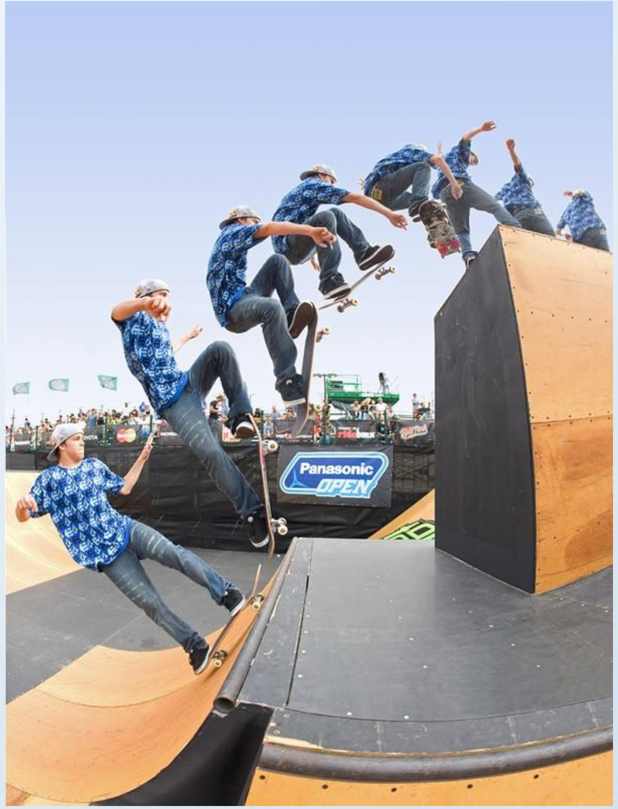
分析节点类型

阈值

修剪方法

CiteSpace可视化原理

前后对比图

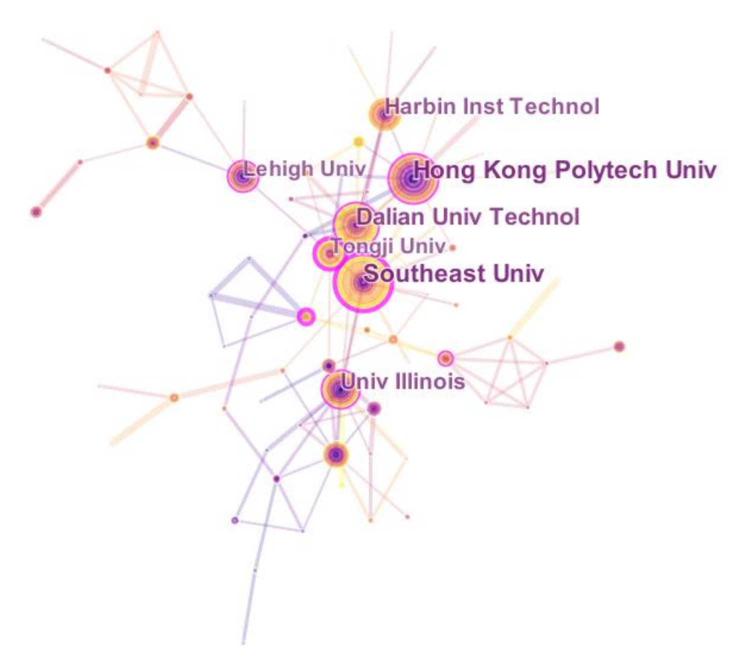


连拍组合

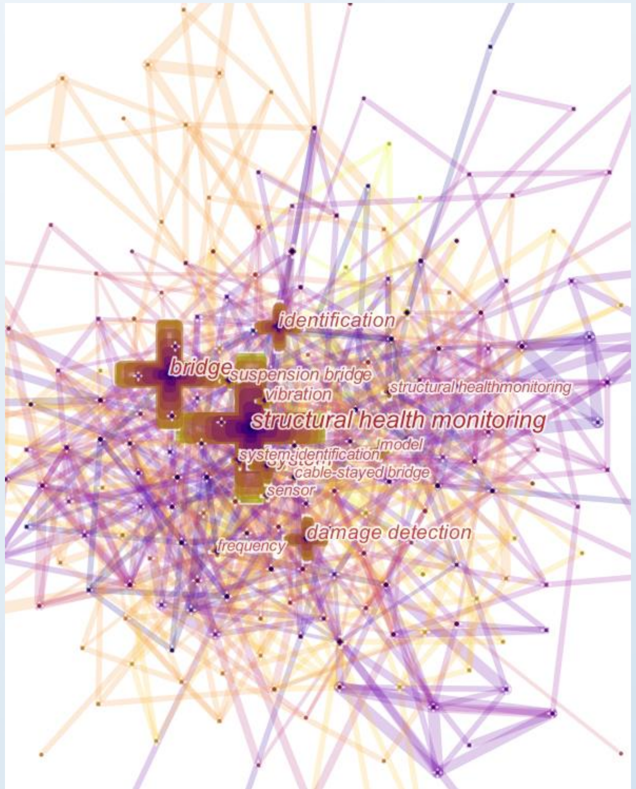
视频或动画

分析节点类型的不同

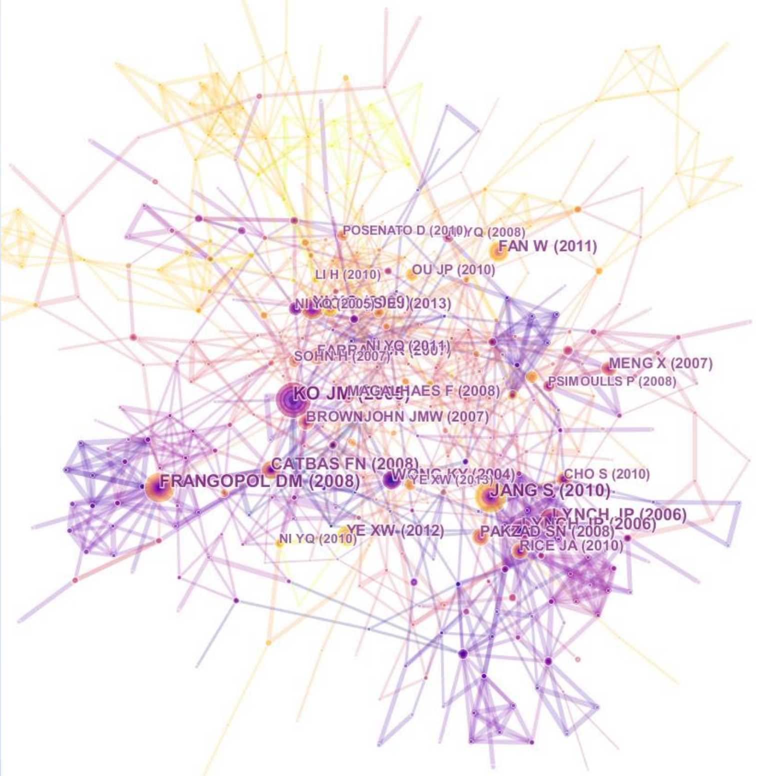
研究机构分析



关键词分析

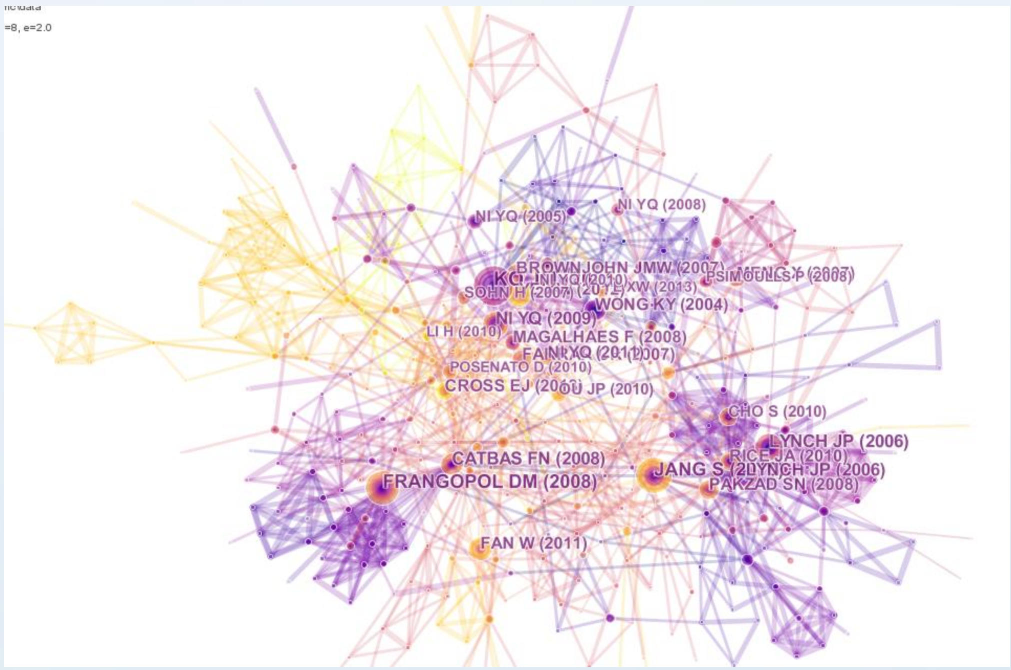


共被引分析

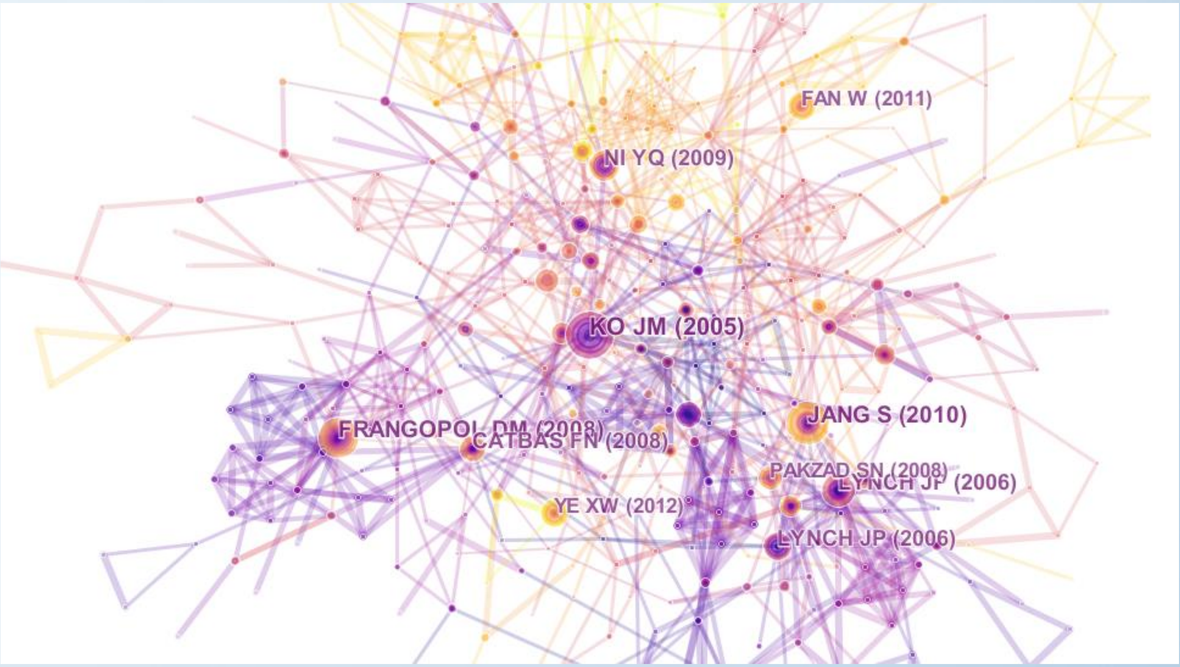


Pathfinder算法的效果

修剪前

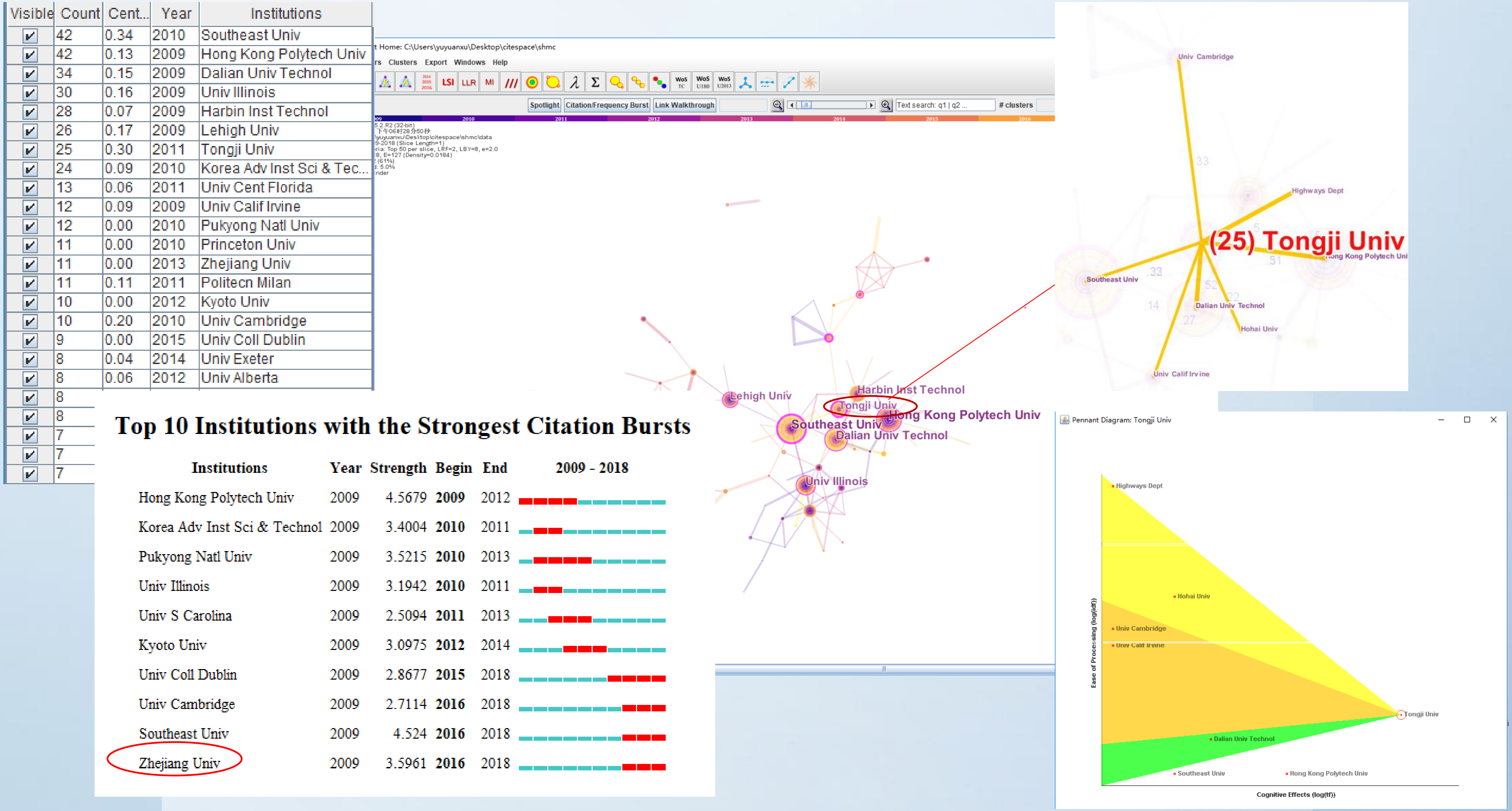


修剪后



Part3：
桥梁健康监测的科学知识图谱

以机构为目标进行分析



Visible	Count	Cent...	Year	Institutions
☑	42	0.34	2010	Southeast Univ
☑	42	0.13	2009	Hong Kong Polytech Univ
☑	34	0.15	2009	Dalian Univ Technol
☑	30	0.16	2009	Univ Illinois
☑	28	0.07	2009	Harbin Inst Technol
☑	26	0.17	2009	Lehigh Univ
☑	25	0.30	2011	Tongji Univ
☑	24	0.09	2010	Korea Adv Inst Sci & Tec...
☑	13	0.06	2011	Univ Cent Florida
☑	12	0.09	2009	Univ Calif Irvine
☑	12	0.00	2010	Pukyong Natl Univ
☑	11	0.00	2010	Princeton Univ
☑	11	0.00	2013	Zhejiang Univ
☑	11	0.11	2011	Politecn Milan
☑	10	0.00	2012	Kyoto Univ
☑	10	0.20	2010	Univ Cambridge
☑	9	0.00	2015	Univ Coll Dublin
☑	8	0.04	2014	Univ Exeter
☑	8	0.06	2012	Univ Alberta
☑	8			
☑	8			
☑	7			
☑	7			
☑	7			

Top 10 Institutions with the Strongest Citation Bursts

Institutions	Year	Strength	Begin	End	2009 - 2018
Hong Kong Polytech Univ	2009	4.5679	**2009**	2012	🟥🟥🟥🟥🟦🟦🟦🟦🟦🟦
Korea Adv Inst Sci & Technol	2009	3.4004	**2010**	2011	🟦🟥🟥🟦🟦🟦🟦🟦🟦🟦
Pukyong Natl Univ	2009	3.5215	**2010**	2013	🟦🟥🟥🟥🟥🟦🟦🟦🟦🟦
Univ Illinois	2009	3.1942	**2010**	2011	🟦🟥🟥🟦🟦🟦🟦🟦🟦🟦
Univ S Carolina	2009	2.5094	**2011**	2013	🟦🟦🟥🟥🟥🟦🟦🟦🟦🟦
Kyoto Univ	2009	3.0975	**2012**	2014	🟦🟦🟦🟥🟥🟥🟦🟦🟦🟦
Univ Coll Dublin	2009	2.8677	**2015**	2018	🟦🟦🟦🟦🟦🟦🟥🟥🟥🟥
Univ Cambridge	2009	2.7114	**2016**	2018	🟦🟦🟦🟦🟦🟦🟦🟥🟥🟥
Southeast Univ	2009	4.524	**2016**	2018	🟦🟦🟦🟦🟦🟦🟦🟥🟥🟥
Zhejiang Univ	2009	3.5961	**2016**	2018	🟦🟦🟦🟦🟦🟦🟦🟥🟥🟥

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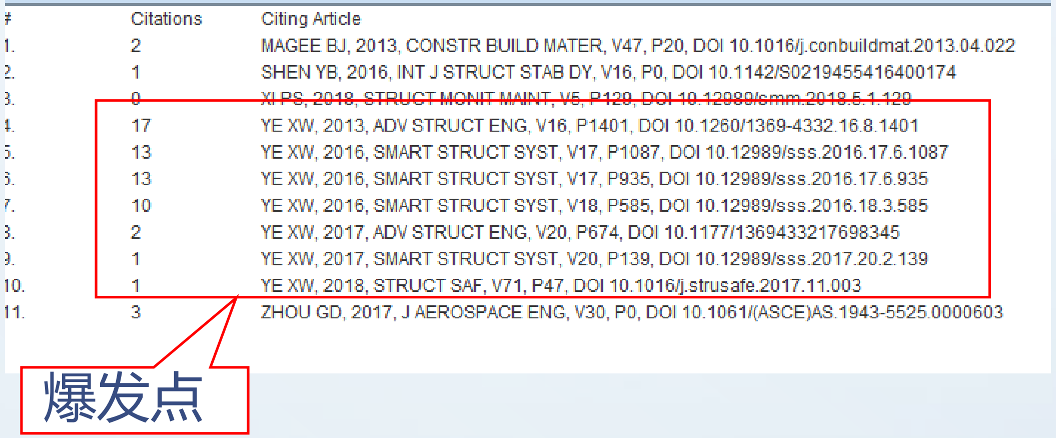
9-2018 (Slice Length=1)
eria: Top 50 per slice, LRF=2, LBY=8, e=2.0
8, E=127 (Density=0.0184)
 (61%)
d: 5.0%
inder
```

以机构为目标进行分析

浙大被引用的文献



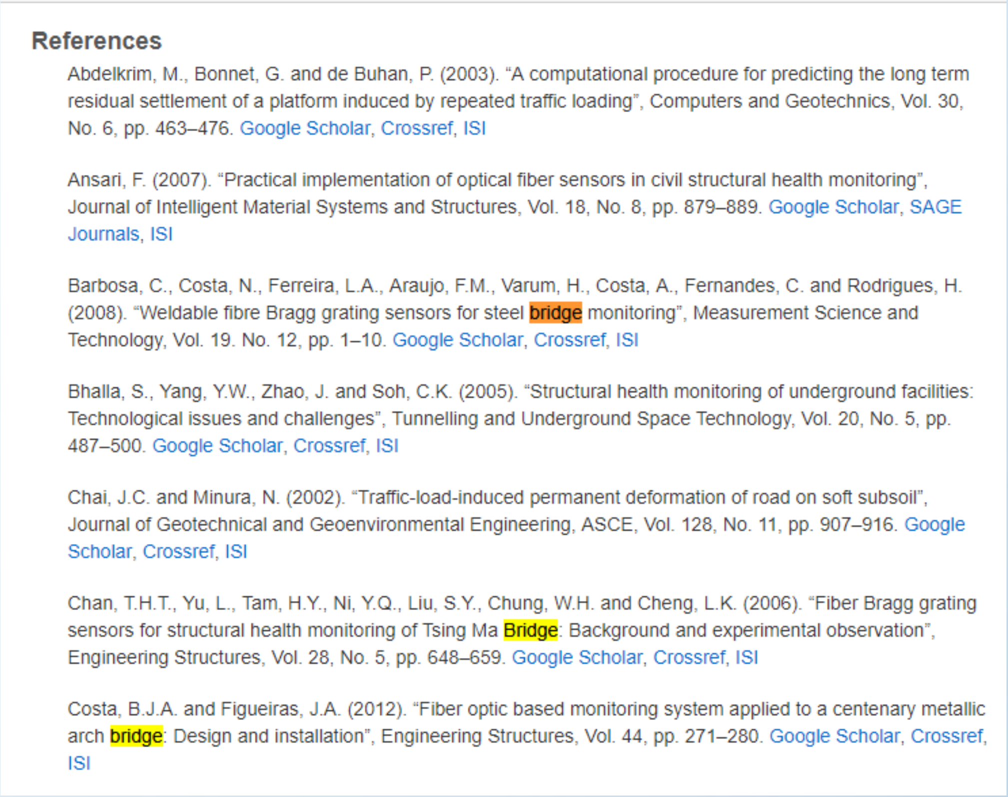
#	Citations	Citing Article
1.	2	MAGEE BJ, 2013, CONSTR BUILD MATER, V47, P20, DOI 10.1016/j.conbuildmat.2013.04.022
2.	1	SHEN YB, 2016, INT J STRUCT STAB DY, V16, P0, DOI 10.1142/S0219455416400174
3.	0	XI PS, 2018, STRUCT MONIT MAINT, V5, P129, DOI 10.12989/smm.2018.5.1.129
4.	17	YE XW, 2013, ADV STRUCT ENG, V16, P1401, DOI 10.1260/1369-4332.16.8.1401
5.	13	YE XW, 2016, SMART STRUCT SYST, V17, P1087, DOI 10.12989/sss.2016.17.6.1087
6.	13	YE XW, 2016, SMART STRUCT SYST, V17, P935, DOI 10.12989/sss.2016.17.6.935
7.	10	YE XW, 2016, SMART STRUCT SYST, V18, P585, DOI 10.12989/sss.2016.18.3.585
8.	2	YE XW, 2017, ADV STRUCT ENG, V20, P674, DOI 10.1177/1369433217698345
9.	1	YE XW, 2017, SMART STRUCT SYST, V20, P139, DOI 10.12989/sss.2017.20.2.139
10.	1	YE XW, 2018, STRUCT SAF, V71, P47, DOI 10.1016/j.strusafe.2017.11.003
11.	3	ZHOU GD, 2017, J AEROSPACE ENG, V30, P0, DOI 10.1061/(ASCE)AS.1943-5525.0000603

爆发点

被引文章的具体信息

AU YE, XW
   NI, YQ
   YIN, JH
TI Safety Monitoring of Railway Tunnel Construction Using FBG Sensing Technology
SO ADVANCES IN STRUCTURAL ENGINEERING
DE railway tunnel; construction monitoring; safety evaluation; FBG sensors;temperature; settlement
AB In comparison with above-ground structures, the investigation of underground space structures still faces great challenges because of the extremely complicated constitutive relationships of the soils or rocks. Implementation of structural health monitoring (SHM) systems on the underground structures such as tunnels commencing from the construction stage may be of help in understanding their operational behaviors and long-term trends. This paper explores the application of the fiber Bragg grating (FBG) sensing technology for safety monitoring during railway tunnel construction. An FBG-based temperature monitoring system is first developed for real-time temperature measurement of the frozen soils during freezing construction of a metro-tunnel cross-passage. Through in-situ deployment of FBG-based liquid-level sensors, the subgrade settlement of a segment of a high-speed rail line is then monitored in an automatic manner during construction of an undercrossing tunnel. The field results indicate that the FBG sensors are robust and reliable in perceiving temperature and strain variations even in harsh environments.
C1
CR Univ Massachusetts Lowell
   Tril Qual Syst
NR 2
TC 17
Z9 0
U1 8
U2 94
J9 ADVANCES IN STRUCTURAL ENGINEERING
PY 2013

引用信息



References

Abdelkrim, M., Bonnet, G. and de Buhan, P. (2003). “A computational procedure for predicting the long term residual settlement of a platform induced by repeated traffic loading”, Computers and Geotechnics, Vol. 30, No. 6, pp. 463–476. Google Scholar, Crossref, ISI

Ansari, F. (2007). “Practical implementation of optical fiber sensors in civil structural health monitoring”, Journal of Intelligent Material Systems and Structures, Vol. 18, No. 8, pp. 879–889. Google Scholar, SAGE Journals, ISI

Barbosa, C., Costa, N., Ferreira, L.A., Araujo, F.M., Varum, H., Costa, A., Fernandes, C. and Rodrigues, H. (2008). “Weldable fibre Bragg grating sensors for steel bridge monitoring”, Measurement Science and Technology, Vol. 19. No. 12, pp. 1–10. Google Scholar, Crossref, ISI

Bhalla, S., Yang, Y.W., Zhao, J. and Soh, C.K. (2005). “Structural health monitoring of underground facilities: Technological issues and challenges”, Tunnelling and Underground Space Technology, Vol. 20, No. 5, pp. 487–500. Google Scholar, Crossref, ISI

Chai, J.C. and Minura, N. (2002). “Traffic-load-induced permanent deformation of road on soft subsoil”, Journal of Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 128, No. 11, pp. 907–916. Google Scholar, Crossref, ISI

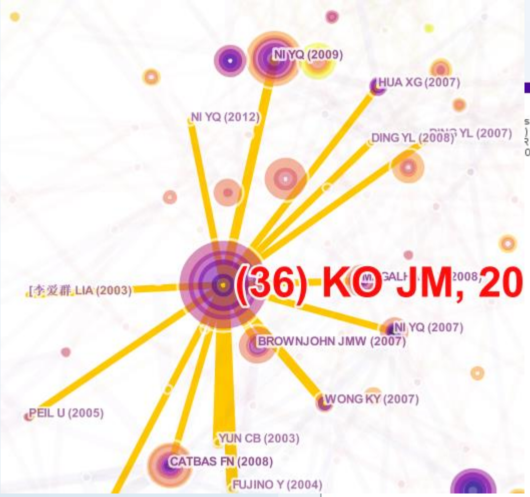
Chan, T.H.T., Yu, L., Tam, H.Y., Ni, Y.Q., Liu, S.Y., Chung, W.H. and Cheng, L.K. (2006). “Fiber Bragg grating sensors for structural health monitoring of Tsing Ma Bridge: Background and experimental observation”, Engineering Structures, Vol. 28, No. 5, pp. 648–659. Google Scholar, Crossref, ISI

Costa, B.J.A. and Figueiras, J.A. (2012). “Fiber optic based monitoring system applied to a centenary metallic arch bridge: Design and installation”, Engineering Structures, Vol. 44, pp. 271–280. Google Scholar, Crossref, ISI

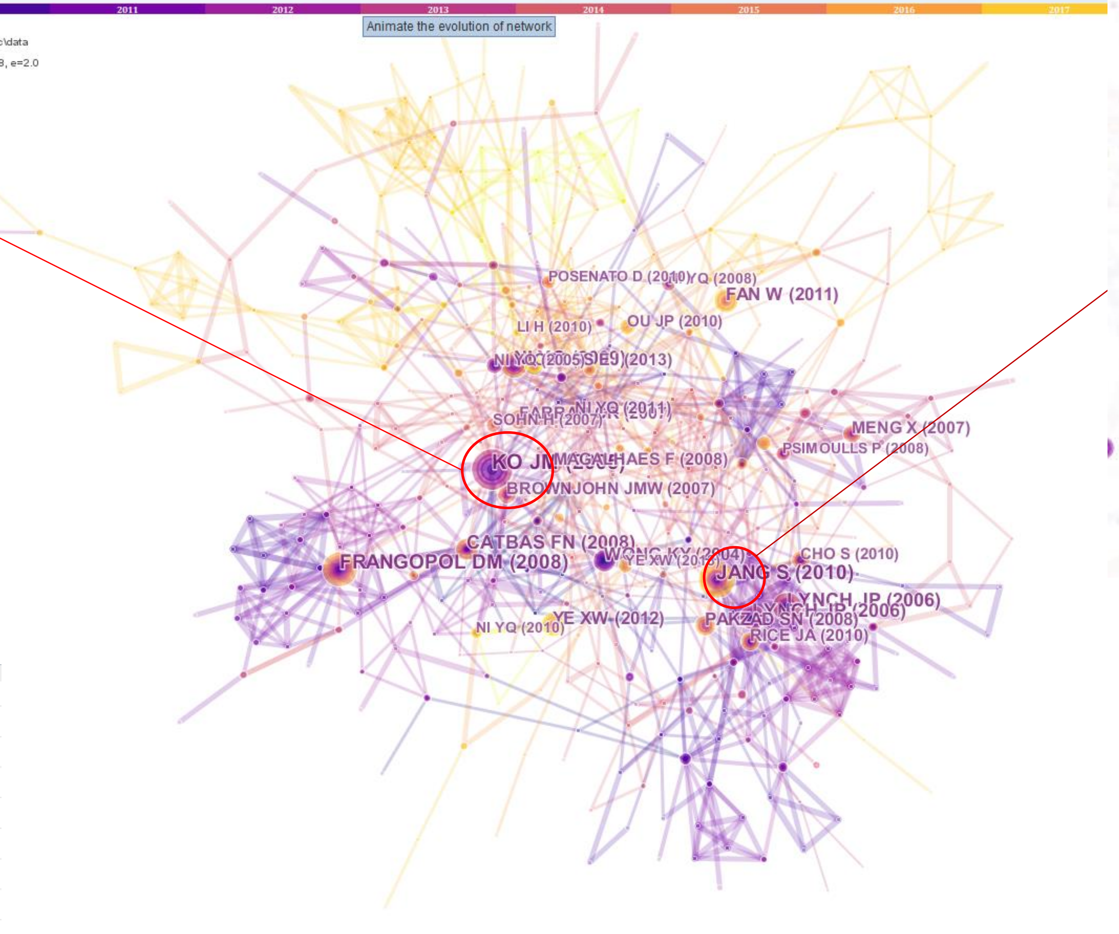
为什么是关于隧道监测的文章？

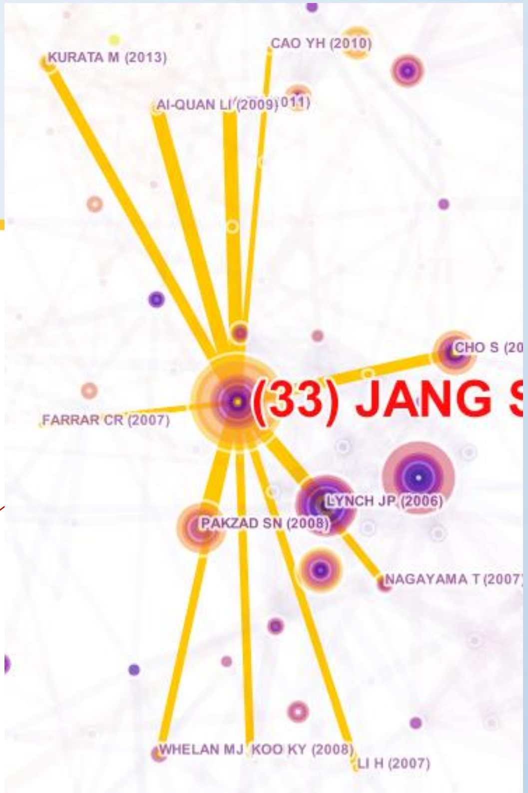
光纤传感器在桥梁上应用的相关文献大多引用了这篇文章

以共被引文献为目标进行分析

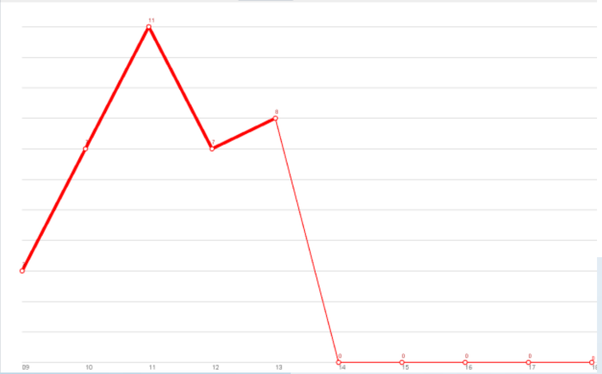


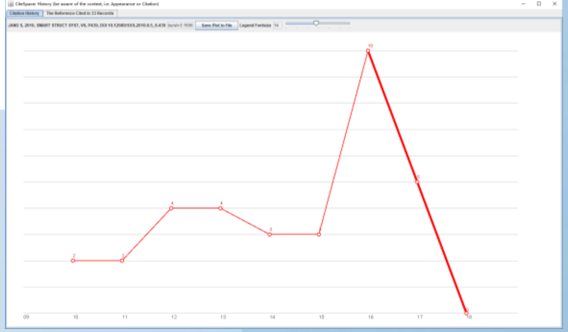
年轮以紫色蓝色为主，
虽然引用数多但最近
引用数很少





年轮从紫色到黄色
都有，是一个持续
的学术热点





连线表示共同被引用，线越粗
代表一起被引用的次数越多

以共被引文献为目标进行分析

Vibration-based Damage Identification Methods: A Review and Comparative Study

Wei Fan, Pizhong Qiao

First Published April 20, 2010 | Review Article | Check for updates

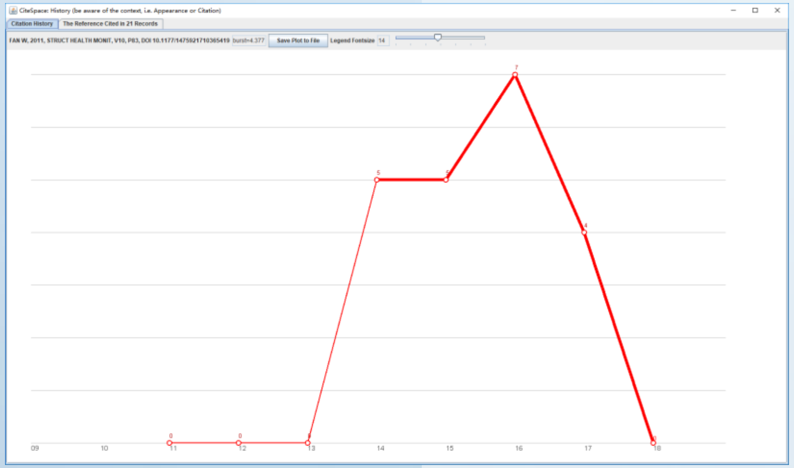
Abstract

A comprehensive review on modal parameter-based damage identification methods for beam- or plate-type structures is presented, and the damage identification algorithms in terms of signal processing are particularly emphasized. Based on the vibration features, the damage identification methods are classified into four major categories: natural frequency-based methods, mode shape-based methods, curvature mode shape-based methods, and methods using both mode shapes and frequencies, and their merits and drawbacks are discussed. It is observed that most mode shape-based and curvature mode shape-based methods only focus on damage localization. In order to precisely locate the damage, the mode shape-based methods have to rely on optimization algorithms or signal processing techniques; while the curvature mode shape-based methods are in general a very effective type of damage localization algorithms. As an implementation, a comparative study of five extensively-used damage detection algorithms for beam-type structures is conducted to evaluate and demonstrate the validity and effectiveness of the signal processing algorithms. This brief review aims to help the readers in identifying starting points for research in vibration-based damage identification and structural health monitoring and guides researchers and practitioners in better implementing available damage identification algorithms and signal processing methods for beam- or plate-type structures.

Keywords

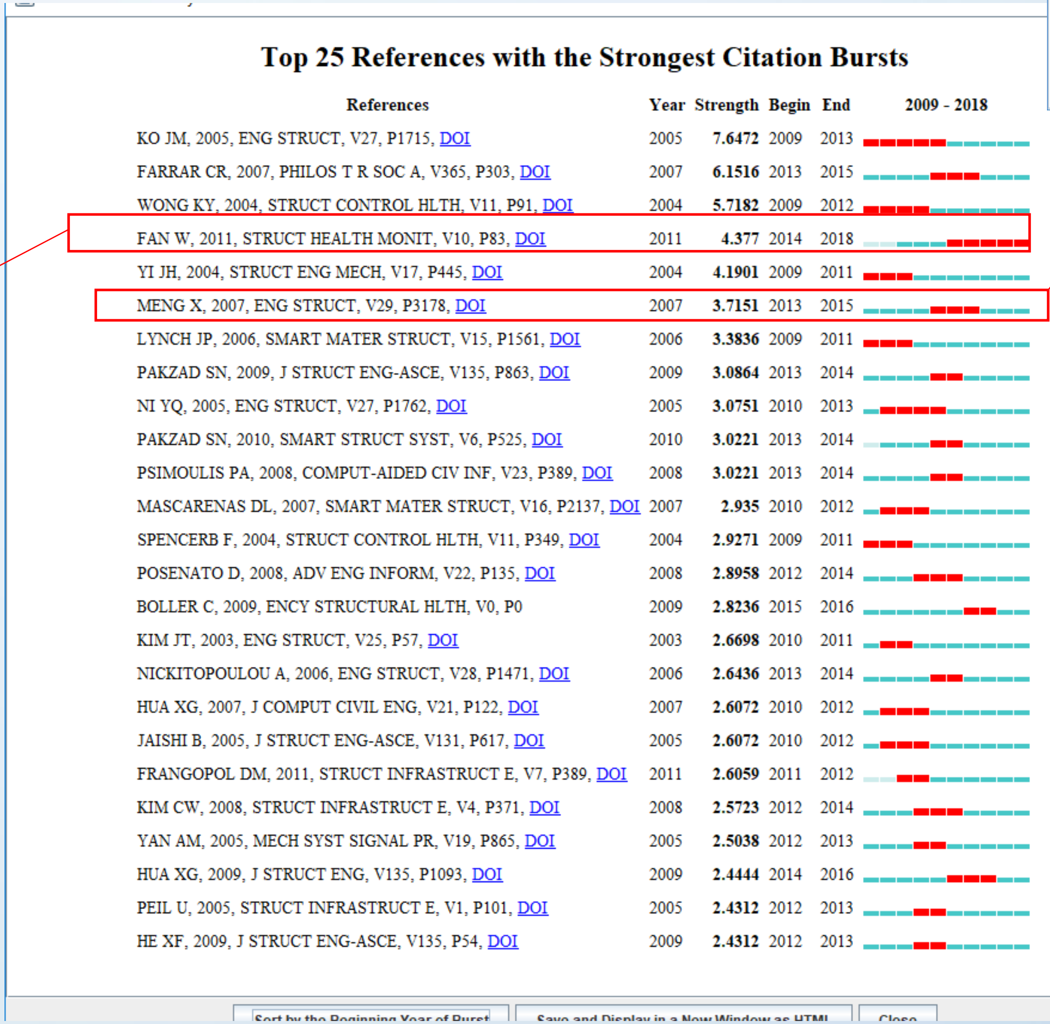
frequency, mode shapes, modal curvatures, vibration, damage identification, beams, plates, signal processing.

学术前沿
文献



CiteSpace: History (be aware of the context, i.e. Appearance or Citation)

FAN W, 2011, STRUCT HEALTH MONIT, V10, P83, DOI 10.1177/1475921710365419 burst=4.377



Top 25 References with the Strongest Citation Bursts

References	Year	Strength	Begin	End	2009 - 2018
KO JM, 2005, ENG STRUCT, V27, P1715, DOI	2005	**7.6472**	2009	2013	🟥🟥🟥🟥🟥🟩🟩🟩🟩🟩
FARRAR CR, 2007, PHILOS T R SOC A, V365, P303, DOI	2007	**6.1516**	2013	2015	🟩🟩🟩🟩🟥🟥🟥🟩🟩🟩
WONG KY, 2004, STRUCT CONTROL HLTH, V11, P91, DOI	2004	**5.7182**	2009	2012	🟥🟥🟥🟥🟩🟩🟩🟩🟩🟩
FAN W, 2011, STRUCT HEALTH MONIT, V10, P83, DOI	2011	**4.377**	2014	2018	⬜⬜🟩🟩🟩🟥🟥🟥🟥🟥
YI JH, 2004, STRUCT ENG MECH, V17, P445, DOI	2004	**4.1901**	2009	2011	🟥🟥🟥🟩🟩🟩🟩🟩🟩🟩
MENG X, 2007, ENG STRUCT, V29, P3178, DOI	2007	**3.7151**	2013	2015	🟩🟩🟩🟩🟥🟥🟥🟩🟩🟩
LYNCH JP, 2006, SMART MATER STRUCT, V15, P1561, DOI	2006	**3.3836**	2009	2011	🟥🟥🟥🟩🟩🟩🟩🟩🟩🟩
PAKZAD SN, 2009, J STRUCT ENG-ASCE, V135, P863, DOI	2009	**3.0864**	2013	2014	🟩🟩🟩🟩🟥🟥🟩🟩🟩🟩
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PSIMOULIS PA, 2008, COMPUT-AIDED CIV INF, V23, P389, DOI	2008	**3.0221**	2013	2014	🟩🟩🟩🟩🟥🟥🟩🟩🟩🟩
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POSENATO D, 2008, ADV ENG INFORM, V22, P135, DOI	2008	**2.8958**	2012	2014	🟩🟩🟩🟥🟥🟥🟩🟩🟩🟩
BOLLER C, 2009, ENCY STRUCTURAL HLTH, V0, P0	2009	**2.8236**	2015	2016	🟩🟩🟩🟩🟩🟩🟥🟥🟩🟩
KIM JT, 2003, ENG STRUCT, V25, P57, DOI	2003	**2.6698**	2010	2011	🟩🟥🟥🟩🟩🟩🟩🟩🟩🟩
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JAISHI B, 2005, J STRUCT ENG-ASCE, V131, P617, DOI	2005	**2.6072**	2010	2012	🟩🟥🟥🟥🟩🟩🟩🟩🟩🟩
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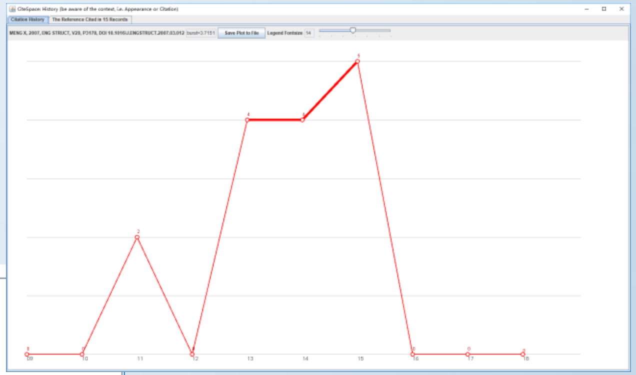
PEIL U, 2005, STRUCT INFRASTRUCT E, V1, P101, DOI	2005	**2.4312**	2012	2013	🟩🟩🟩🟥🟥🟩🟩🟩🟩🟩
HE XF, 2009, J STRUCT ENG-ASCE, V135, P54, DOI	2009	**2.4312**	2012	2013	🟩🟩🟩🟥🟥🟩🟩🟩🟩🟩



CiteSpace: History (be aware of the context, i.e. Appearance or Citation)

MENG X, 2007, ENG STRUCT, V29, P3178, DOI 10.1016/J.ENGSTRUCT.2007.03.012 burst=3.7151

突然复活
的文献

Detecting bridge dynamics with GPS and triaxial accelerometers

X. Meng, A.H. Dodson, G.W. Roberts

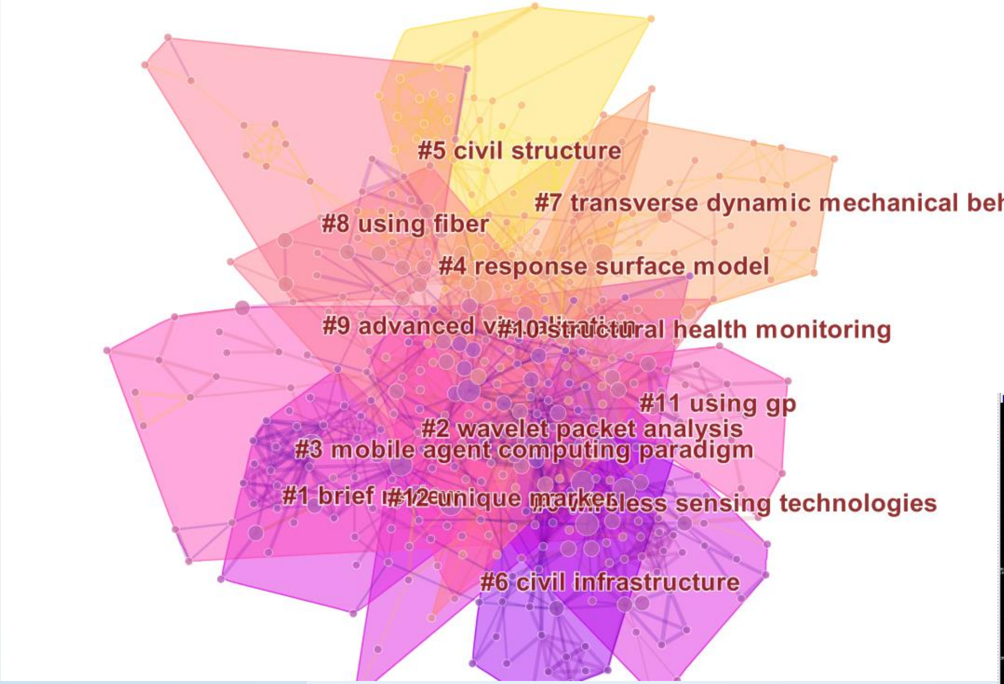
https://doi.org/10.1016/j.engstruct.2007.03.012

Abstract

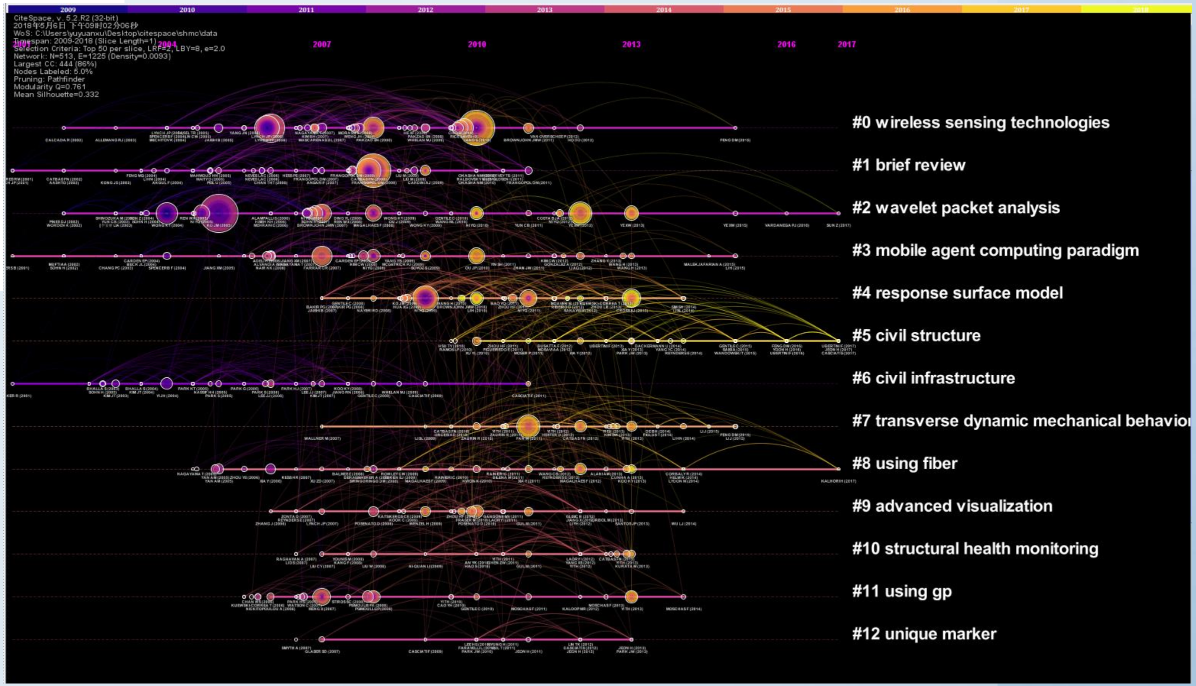
GPS and triaxial accelerometers have been used in field tests to record the response of the Wilford Bridge, a suspension footbridge over the River Trent in Nottingham, to forced vibration excited by more than 30 people with a total weight of 2353 kg, as well as subsequent decayed free vibration and ambient vibration caused by casual pedestrian traffic and weak wind loading. A peak-picking approach based on the bandpass filtering technique and Fast Fourier Transform (FFT) is employed to extract dominant local vibration frequencies and relevant vibration amplitudes of the bridge. It is found that the maximum frequency discrepancies between ambient and forced vibrations and that for ambient excitation against decayed vibration are 2.5% and 3.0%, respectively. The maximum frequency difference between different excitation manners is less than 2%. This provides evidence that precise structural natural frequencies of the bridge can be estimated from either the responding measurements of decayed free vibration or ambient vibration. These estimated frequencies, using GPS and accelerometer measurements, match well with the predictions from a dedicated Finite Element (FE) model created for the bridge. This paper concludes that GPS is a viable tool for both structural deflection monitoring and natural frequency detection and the measurements from a triaxial accelerometer can be used to validate the estimated dynamics from the GPS measurements and improve the overall monitoring system performance.

以共被引文献为目标进行分析

通过聚类，将文献分为几大类，找出中心文献和枢纽文献



由于研究领域较为接近，图谱较为杂乱，重叠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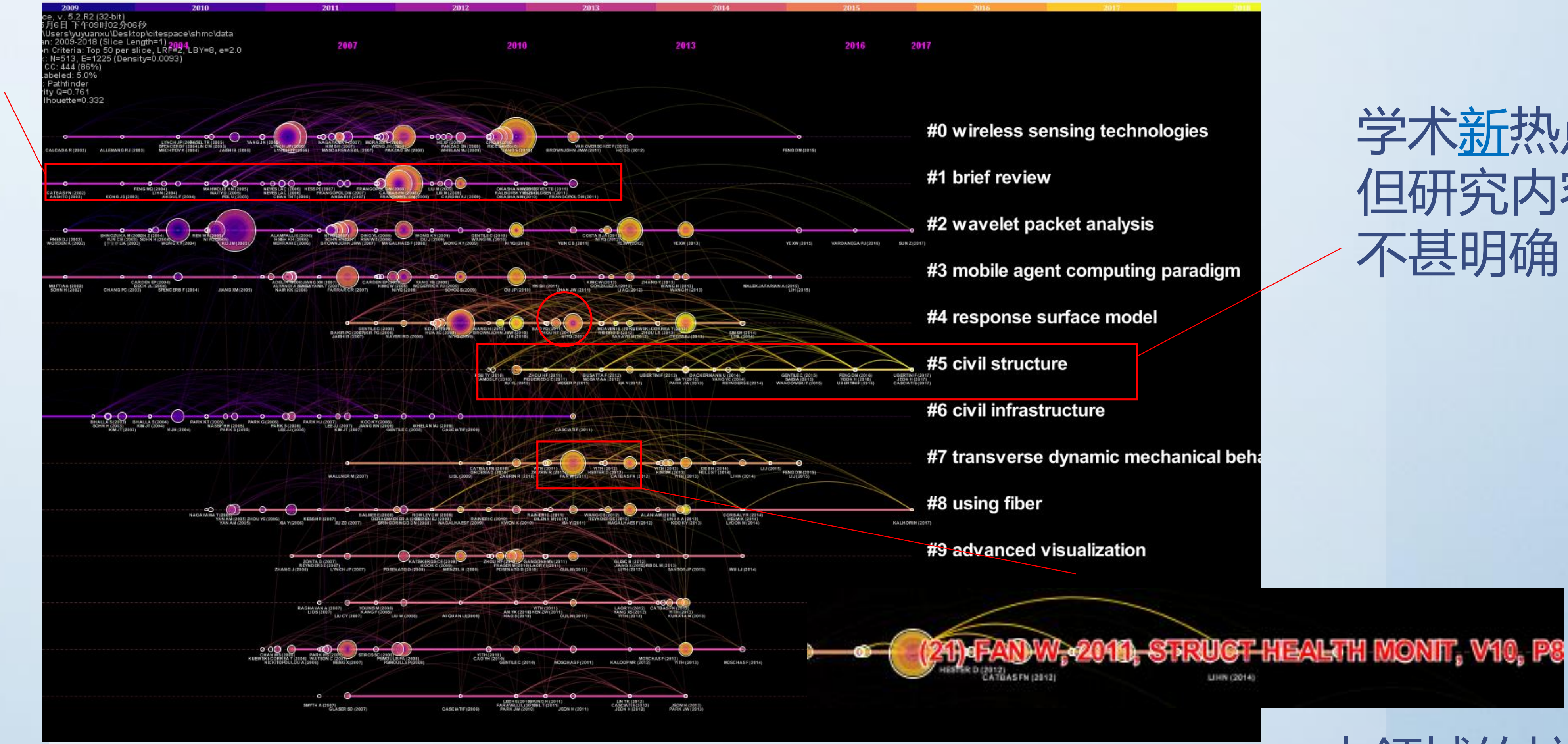
WoS: C:\Users\yuyuanxu\Desktop\citespace\shmc\data
Timespan: 2009-2018 (Slice Length=1)
Selection Criteria: Top 50 per slice, LRF=2, LBY=8, e=2.0
Network: N=513, E=1225 (Density=0.0093)
Largest CC: 444 (86%)
Nodes Labeled: 5.0%
Pruning: Pathfinder
Modularity Q=0.761
Mean Silhouette=0.332

通过时域图，理清各个研究区域的关系

以共被引文献为目标进行分析

有过高峰，
但学术热
度下降



学术新热点，
但研究内容
不甚明确

本领域的核心，
但和其他领域
交叉较少

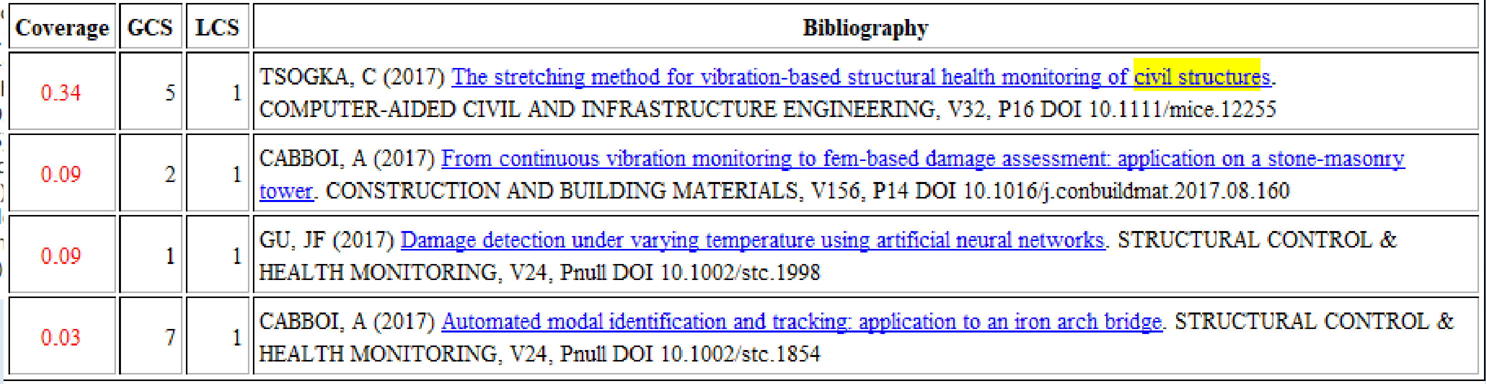
横轴为文献出现的时间
每一根横轴上的文献代表一个聚类
连线表示同时被引

以共被引文献为目标进行分析

1.利用一种地球物理中采用的算法，直接识别出结构自然频率的永久变化，减少系统的训练时间，实现持续监测
2.利用自动模态识别和自动更新有限元模型，对结构持续监测其损伤
3.利用人工神经神经网络探伤
4.自动的模态识别系统和追踪在铁拱桥上的应用

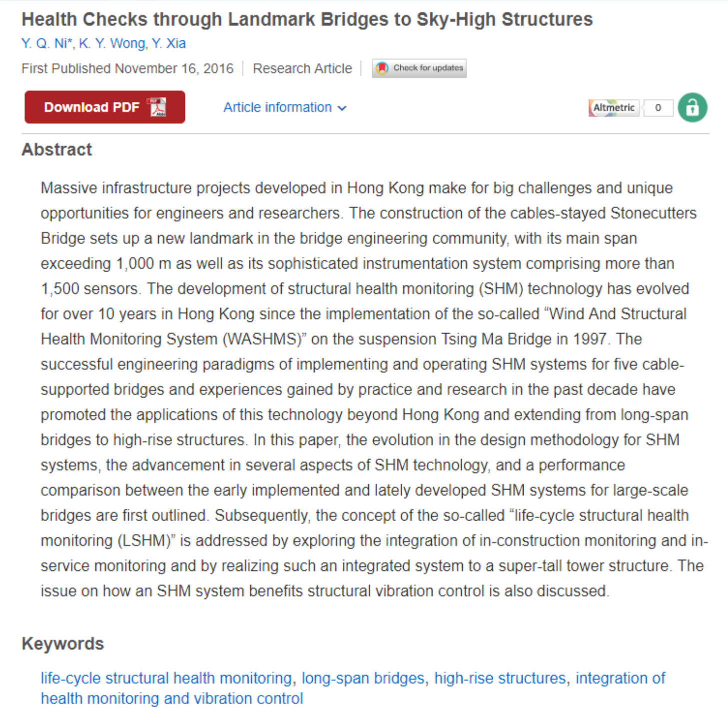
聚类号	文献总数	中心度	平均出现时间	LSI算法得到的关键词	LLR算法得到的关键词
5	35	0.908	2013	structural damage detection; selection; lag length; stationarity-based approach; cointegration analysis; fusing visp; long-span cable-stayed bridge; long-term performance assessment; high-speed 6-dof structural displacement monitoring; extended kalman filter | application; tracking; automated modal identification; iron arch bridge; data-fusion; validation; visual-inertial displacement; vision-based displacement; acceleration; sensing using data fusion	civil structure (2360.24, 1.0E-4); vibration-based structural health monitoring (2360.24, 1.0E-4); stretching method (2360.24, 1.0E-4); using artificial neural network (261.74, 1.0E-4); varying temperature (261.74, 1.0E-4); fem-based damage assessment (116.34, 1.0E-4); stone-masonry tower (116.34, 1.0E-4); continuous vibration monitoring (116.34, 1.0E-4); multilayer artificial neural network (50.81, 1.0E-4); natural frequency-based damage detection (50.81, 1.0E-4); masonry tower (50.81, 1.0E-4); fe model updating (50.81, 1.0E-4); iron arch bridge (45.39, 1.0E-4); damage identification (45.15, 1.0E-4); kalman filter (43.56, 1.0E-4); wireless sensing technologies (39.68, 1.0E-4); temperature effects (38.37, 1.0E-4); sensor fusion (36.31, 1.0E-4); complementary filter (36.31, 1.0E-4); damage detection (34.07, 1.0E-4); bridge monitoring (32.08, 1.0E-4); displacement measurement (30.32, 1.0E-4); damage localization (29.06, 1.0E-4); cointegration (29.06, 1.0E-4); environmental and operational conditions (29.06, 1.0E-4); environmental effects (28.32, 1.0E-4); civil infrastructure (27.79, 1.0E-4); mobile agent computing paradigm (24.95, 1.0E-4); flexible structural health monitoring sensor network (24.95, 1.0E-4); brief review (24.18, 1.0E-4); life-cycle design (24.18, 1.0E-4); automated modal identification (24.14, 1.0E-4); truss structure (21.8, 1.0E-4); singular spectrum analysis (21.8, 1.0E-4); armax (21.8, 1.0E-4); rank-revealing qr decomposition (21.8, 1.0E-4); damage sensitivity (21.8, 1.0E-4); automatic modal identification (19.66, 1.0E-4); computer vision (19.42, 1.0E-4); vibration monitoring (16.96, 1.0E-4); wavelet packet analysis (16.89, 1.0E-4); structural damage warning (16.89, 1.0E-4); long-span cable-stayed bridge (16.46, 1.0E-4); using novelty detection technique (16.46, 1.0E-4); response surface model (15.7, 1.0E-4); mechanisms (15.18, 1.0E-4); mid-span deflection (15.18, 1.0E-4); structural dynamics (15.01, 0.001); single-valued damage index (14.53, 0.001); damage detection and localization (14.53, 0.001); moving time windows (14.53, 0.001); environmental and operational variability (14.53, 0.001); early damage detection (14.53, 0.001); mode shape curvature (14.53, 0.001); cost-effective bridge management (14.08, 0.001); financial constraint (14.08, 0.001); computational earthquake engineering (12.89, 0.001); principal component analysis (12.84, 0.001); steel bridge (11.86, 0.001); fatigue life assessment (11.59, 0.001); time series analysis (11.48, 0.001); structural health monitoring data (11.27, 0.001); statistical analysis (11.21, 0.001); transverse dynamic mechanical behavior (11.16, 0.001); using fiber (11.16, 0.001); train load (11.16, 0.001); axle detection (11.16, 0.001); stress spe motion system (11.16, 0.001); optic sensor (11. (10.77, 0.005); concrete-steel composite cross- girder connection (10.62, 0.005); bayesian met bridges (9.96, 0.005); advanced visualization (9 structural health monitoring (shm) (9.23, 0.005 structure technologies (8.04, 0.005); symbolic c 0.005); structural health monitoring (7.79, 0.01) machine learning (7.27, 0.01); cablestayed brid (visp) (7.27, 0.01); inertial measurement unit (i models (7.27, 0.01); mobile sensors (7.27, 0.01) 0.01); snr (7.27, 0.01)

该聚类的主要文献



Coverage	GCS	LCS	Bibliography
0.34	5	1	TSOGKA, C (2017) The stretching method for vibration-based structural health monitoring of civil structures. COMPUTER-AIDED CIVIL AND INFRASTRUCTURE ENGINEERING, V32, P16 DOI 10.1111/mice.12255
0.09	2	1	CABBOI, A (2017) From continuous vibration monitoring to fem-based damage assessment: application on a stone-masonry tower. CONSTRUCTION AND BUILDING MATERIALS, V156, P14 DOI 10.1016/j.conbuildmat.2017.08.160
0.09	1	1	GU, JF (2017) Damage detection under varying temperature using artificial neural networks. STRUCTURAL CONTROL & HEALTH MONITORING, V24, Pnull DOI 10.1002/stc.1998
0.03	7	1	CABBOI, A (2017) Automated modal identification and tracking: application to an iron arch bridge. STRUCTURAL CONTROL & HEALTH MONITORING, V24, Pnull DOI 10.1002/stc.1854

以共被引文献为目标进行分析



Health Checks through Landmark Bridges to Sky-High Structures

Y. Q. Ni*, K. Y. Wong, Y. Xia

First Published November 16, 2016 | Research Article

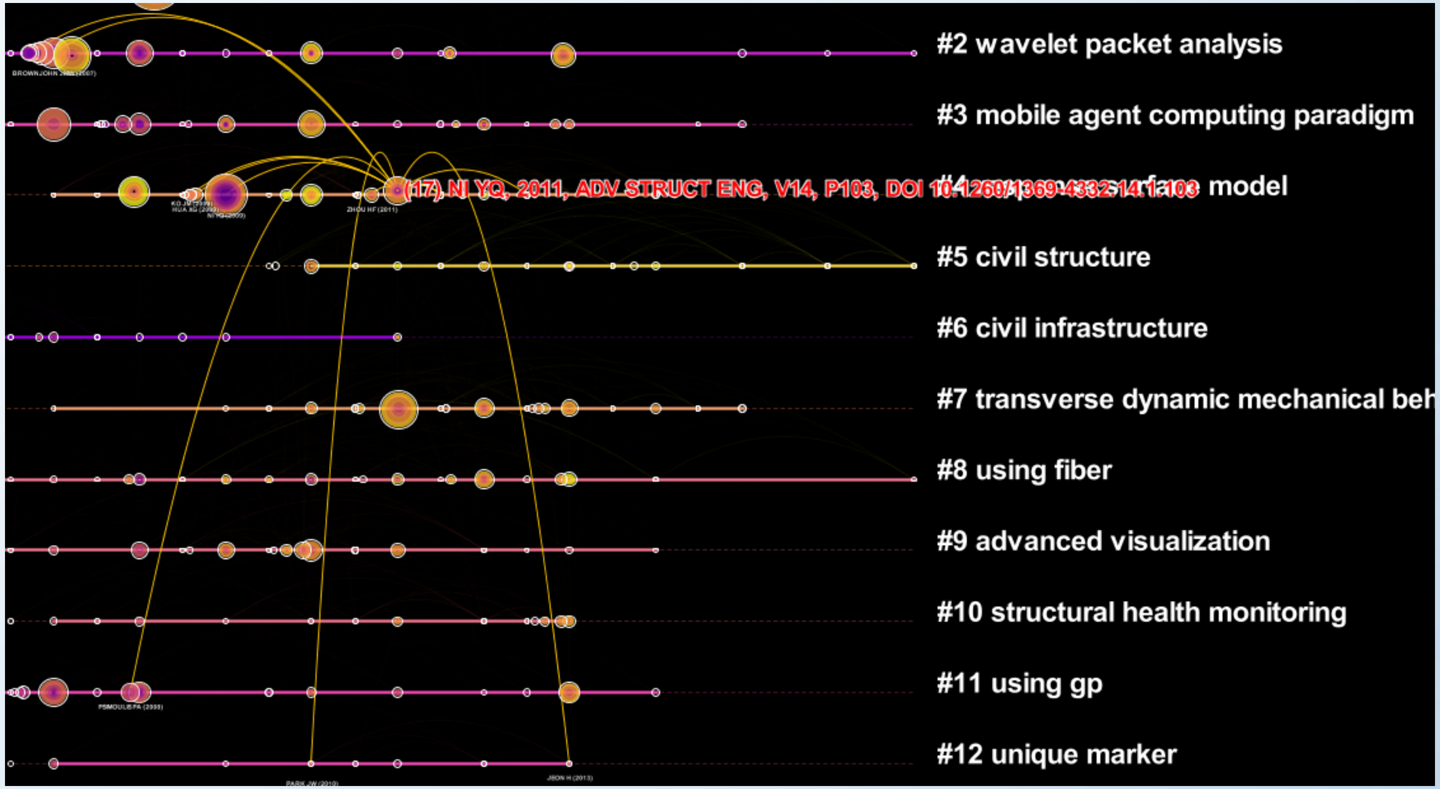
Abstract

Massive infrastructure projects developed in Hong Kong make for big challenges and unique opportunities for engineers and researchers. The construction of the cables-stayed Stonecutters Bridge sets up a new landmark in the bridge engineering community, with its main span exceeding 1,000 m as well as its sophisticated instrumentation system comprising more than 1,500 sensors. The development of structural health monitoring (SHM) technology has evolved for over 10 years in Hong Kong since the implementation of the so-called “Wind And Structural Health Monitoring System (WASHMS)” on the suspension Tsing Ma Bridge in 1997. The successful engineering paradigms of implementing and operating SHM systems for five cable-supported bridges and experiences gained by practice and research in the past decade have promoted the applications of this technology beyond Hong Kong and extending from long-span bridges to high-rise structures. In this paper, the evolution in the design methodology for SHM systems, the advancement in several aspects of SHM technology, and a performance comparison between the early implemented and lately developed SHM systems for large-scale bridges are first outlined. Subsequently, the concept of the so-called “life-cycle structural health monitoring (LSHM)” is addressed by exploring the integration of in-construction monitoring and in-service monitoring and by realizing such an integrated system to a super-tall tower structure. The issue on how an SHM system benefits structural vibration control is also discussed.

Keywords

life-cycle structural health monitoring, long-span bridges, high-rise structures, integration of health monitoring and vibration control

文献的具体内容



文献枢纽点,被多个领域同时引用

Part4：
总结

总结

优点

- 在展示学科发展过程的同时保持了足够的细节
- 全面展现了一篇文献对学术界的影响，找出了学术发展过程中的中心点，枢纽点和爆发点
- 找出了不包含在原有数据库中的重要文献，拓宽了学术视野和跨领域交流

缺点

- 支持的数据库类型有限，目前仅对SCI有较为良好的效果
- 对于聚类的命名还需要改进
- 对于图谱的解读仍需要足够的专业知识

谢谢大家